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DR. RICHARD DE ZEEUW publishes a helpful paper in the *Centralblatt für Bacteriologie, Parasitenkunde und Infektionskrankheiten*, 1911, on the "Comparative Viability of Seeds, Fungi and Bacteria when Subjected to Various Chemical Agents," in which he shows that the disinfection of seeds, etc., is by no means as easily accomplished as has been supposed, and that the results of many experiments requiring disinfection are open to criticism.

WE can not pass by without at least brief mention the *Journal of the College of Agriculture of the Imperial University of Tokyo* (Japan), in the December number of which are two articles by Professor Dr. S. Kusano, the first, on "*Gastrodia elata* and its Symbiotic Association with *Armillaria mellea*," showing that this chlorophyll-less orchid lives in a beneficially symbiotic relation with the mycelium of the fungus. The second paper, "On the Root-Cotton, a Fibrous Cork Tissue of a Tropical Plant" (*Fagara integrifolia*), shows that "the root-cotton is a kind of cork tissue derived from the cork cambium, which arises primarily from the pericycle or secondarily from the bast of the root." The author concludes that it is of economic value, "chiefly in its unwettable and less hygroscopic quality." The papers are illustrated by seven very fine plates.

CHARLES E. BESSEY

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THE RELATION OF PIGMENTATION TO TEMPERATURE IN DEEP-SEA ANIMALS

PROFESSOR C. V. BURKE's article on the relation of color of certain sea-animals to the depth at which they live¹ is of much more than ordinary importance, for it may be possible to coordinate these facts with similar ones as to tropical land animals which show that pigmentation is of great, if not vital importance in heat regulation. In nearly all the biological literature on the subject, it is assumed that the sole use of pigment is for concealment by

more or less resemblance to something in the background or to the background itself. This may be true of all colors but pigment of any color, if opaque enough, may protect underlying tissues from death due to excessive light, a matter to which von Schmaedel first called attention as to man, nearly twenty years ago. This rule has now been found to be universal, for in every species there is a pigment or other protection proportionate to the intensity of the light. In the 1887 *Proceedings of the Royal Society of Edinburgh*, Dr. Robert Wallace, now professor of agriculture in the University of Edinburgh, published another epoch-making observation, which, like that of Mendel and of many others, was completely ignored for a quarter century. Wallace found that all the domestic mammals of the tropics had black skins, and though Huxley was much impressed by the universality of the phenomenon, he could suggest no reason for it because up to the time of his death very little was known as to the deadliness of the shorter ether waves to all naked living tissues, such as in the case of bacteria for instance; and though we then used sunlight to "disinfect," by killing our parasites, no one had yet perceived that it could also kill us. It is now known that the main purpose is light protection, and there is a wealth of evidence that if unpigmented stock is taken from dark climates to light ones it dies out. The agricultural experimenters have utterly failed to establish the big white swine in our west or in any light climate and at the present moment, in many parts of the world, farmers are vainly trying to breed imported stock insufficiently pigmented. The matter is of such great practical importance that it must be cleared up at once to stop the present wasteful methods.

It has also long been known that black assists heat radiation in all temperatures below body heat. These black-skinned domestic animals are then the fittest for tropical temperatures, but they can not expose themselves to the sun because of the fatal absorption of heat. They instinctively hide in the day, if the skin is not covered by a reflecting coat as in the Arab horse. In cold light countries

¹ SCIENCE, October 6, 1911.

excessive radiation is prevented by fur and hair, as in the black skinned Mongolian pony. The black skinned animals with little or no hair are therefore restricted to a very limited thermal range, while those with hair or fur protection are healthy in all extremes.

Some recent observations of horses in the Philippines, Japan and Korea have shown that slight differences in climate make great differences in hair color and it seems to depend more largely on air temperature than was formerly thought. The detailed data were published in a preliminary article in the September number of the *U. S. Cavalry Journal*, but the point of present interest is the relation of pigment to the environmental temperature.

Every kind of protoplasm has a very limited thermal range in which it functions best; in some cases there is practically no range at all for the function is disturbed by even a half degree of change. Every kind of protoplasm can live if subjected to higher or lower temperatures than its optimum even if it ceases functioning. But it is to be noted that no kind can stand very much rise of temperature, though it may be chilled to the absolute zero for a short while. The upper thermal death point is therefore so near the usual range and the malfunctioning due to any rise is so great, that each species adopts some safeguard against overheating. In the land mammals it is always some method of radiation or evaporation of perspiration and a dark color seems vital for the purpose of radiation in all temperatures below body heat. It is amazing to see the differences in horse colors in different localities according to temperature in Japan, Korea and wherever there has been no check to the process by importations for some centuries. Where there is heat to reflect at any season the color is light or white.

One of the puzzles of zoology has been to account for dense pigmentation where there is very little light. If there is complete darkness, as in some caves, the color of fishes is apt to disappear entirely by selection on the ground of economy, the pigment evidently being an expensive drain on the resources. As

fish are said to have a temperature but little above that of the water in which they live, there is evidently little or no need for them to have safeguards against overheating or chilling in a medium, never hot enough to be injurious nor below 40° F. as a rule. Hence coloration of fishes has been invariably interpreted as for concealment, and the facts certainly do point to that reason.

In the deep sea, on the other hand, we have vastly different conditions. The only light is a phosphorescence which is usually so faint as to require very large eyes, yet some investigators assure us that it can be so intense as to demand dense pigmentation for concealment. This may account for the fact that the pigment is often spread all over the body, as would be necessary if the light comes from all directions and not always from above, as in the fishes of the upper layers. Yet there are curious exceptions, as though some deep sea places were as dark as caves, for some species have little or no pigment and some have no eyes; but as far as known, the relation between these facts, if there is any relation at all, has never been explained or proved.

With regard to deep sea temperatures we are assured that generally they are very low, specimens being too cold to handle. Salt water at such pressures can be much below 32° F. without freezing, and it is often found at a degree which prevents all activity of fish in surface waters. They "hibernate" in such chilly surroundings. There must then be a different law as to the relation of the body temperature of deep sea fish to the water surrounding them. All the mammals of the sea are densely pigmented and generally all over. They are never subjected to high temperatures nor to anything lower than 32°, and have no need for protection from extremes. The pigment then must be for light protection. They all prevent undue heat loss by the thick layer of insulating fat, so the radiation of heat by the black color can do no more harm than in the case of black cattle which are found in mild temperate climates. Black pigments can not be for the purpose of absorbing heat from the sun's rays, for all such animals avoid the

sun, nor can sea-mammals absorb to any extent that way as the heat does not penetrate enough. The surrounding medium is always below body temperature and the heat flow is always from the body not into it. As all mammals seem to depend upon more or less constant loss of superfluous heat by radiation and much loss during exertion, the black colors are probably of as great use to whales and porpoises, as to elephants and similar hairless tropical animals who likewise are never exposed to extremes and whose ranges of temperature do not differ markedly from those of the sea mammals. That is, there must be, as in horses, some means of preventing overheating, and color surely helps according as the animal is shaded or exposed to the sun. The amazing differences in horses can be logically explained on these lines, as seen in the above paper. Hence there is a suspicion that dark color in all sea-fishes at any depth has some unknown relation to the temperature, as well as the need of concealment. It must be remembered that the inner surfaces of shells, and the concealed surfaces of some parts of the bodies of many animals are most unaccountably pigmented. Neither the food nor protection from light nor resemblance to the background can be the reason, nor can it be a vestige of a previous useful condition. Indeed it is a puzzle which needs explanation, and it is requested that in all future studies there be facts presented as to the temperature of both the water and the body of the animal. It is not likely that the deep-sea fish can function at such low temperatures as we are told do exist, and it is probable that we shall find that where life is abundant the temperature of both fish and water is considerably above 40° but that in the vast areas where no life at all is found the cold may be the prohibitive factor. There must be as great variation from place to place by reason of currents as in the air. The prevalent winds make only a few degrees difference between the temperature of the northeast and southwest of Japan, but the horses in the first place are dark brown and in the latter light yellow for this reason alone. There must be similar local differences

in the deep sea, due to currents to account most fully for differences in pigmentation. If the color darkens with increasing depth and coldness, then the animals surely lose by radiation what little heat they have and must be unable to function at all. Unless, then, there are different laws for the deep sea life, of which we can not conceive at present, there must be another reason for a concealing blackness which would be a fatal radiator to ancestral types nearer the surface. Indeed there may be some unknown laws of heat radiation under such tremendous pressures, which actually reverse matters and make the pigment a conserver of body heat in cold water. It can scarcely be believed that the color is to help absorption of heat, for there is little to be absorbed—the animal must depend on its own heat production. That is, the facts so far known do not explain the blackness of the deep sea fish.

CHAS. E. WOODRUFF

PHYSIOLOGICAL SEX DETERMINATION

AN interesting, if not convincing, collation of arguments in support of the notion that the suprarenal capsules are concerned in determining the sex of offspring was presented to the Paris Academy of Sciences on November 20, 1911, by Dr. R. Robinson. His arguments fall into three groups.

1. *Clinical observations.*

It has been shown by Dr. Fieux Agregi, of Bordeaux, that when the heart-beat of the foetus is between 136 and 150 per minute there is born a female in 68 per cent. of the cases; if the heart-beat is more than 150 it is always a male. He had fifty cases. Robinson not only confirmed Agregi's observations, but was able to determine the retarding action of the administration of adrenalin upon the pulse of the foetus. He therefore presumes that if this substance were administered from the early days of pregnancy it would influence the heart-beat and so the sex of the foetus.

2. *Anatomo-physiological facts.*

The adrenal glands seem to influence the development of the individual after birth, if they do not cause the determination of the